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Atty. Dkt. No. 200312941-1

JUL 25 2006

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Bokelman et al.

Title: Media Detection

Appl. No.: 10/789,633

Filing Date: 2/27/2004

Examiner: Joerger

Art Unit: 3653

DECLARATION UNDER 37 C.F.R. 1.131

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

We, Kevin Bokelman, Craig A. Maurer, and Daniel H. Wee, state and declare that:

1. Each of us is an inventor of at least one of originally filed Claims 1-36 of U.S. Patent Application Serial No. 10/789,633, filed on 2/27/2004, and entitled "Media Detection."
2. We understand that in an Office Action dated May 3, 2006, claims 1-36 of the 10/789,633 patent application were rejected based on U.S. Patent No. 6,926,272 to Carter et al.
3. We understand, based on the information provided on the front page of U.S. Patent No. 6,926,272, that U.S. Patent No. 6,926,272 was filed on August 12, 2003.

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Jul 20 06 02:32p

KEVIN BOKELMAN

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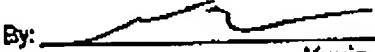
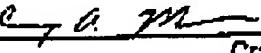
p.2

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4. Prior to August 12, 2003, we conceived in the United States the invention described in claims 1-36 of the above-referenced Application as evidenced by the attached Exhibit A.

5. Exhibit A is a redacted copy of an invention disclosure which was written and dated prior to August 12, 2003. Exhibit A generally describes a method and apparatus for sensing media.

6. We hereby declare that all statements made herein of our own knowledge are true, and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: July 10, 2006By: 
Kevin BokelmanDate: July 20, 2006By: 
Craig A. MaurerDate: July 20, 06By: 
Daniel H. Wee

Atty. Dkt. No. 200312941-1

Exhibit A



Disclosure No. 200312941

Invention Disclosure - DBI Document No. 7CBH

PD No.
200312941

Date/Time Submitted
[REDACTED]

Collection
IPG

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General Information

Title Method to use a single channel optical switch to sense more than two states

Abstract Single channel optical switches are used ubiquitously in consumer electronic products, but they are only able to indicate to a processor two states (blocked/unblocked). This invention allows a single channel optical switch to sense more than two states through novel interruptor designs.

Projects Lisa AiO

Products Lisa AiO

Attachments

Attachments [The_Evolution_of_the_Lisa_Edge_Detect_Flag.doc \[101376 bytes\]](#) - [REDACTED] :44PM - The evolution of the edge flag. (Uploaded by Kevin Bokelman)

Description of Invention

Problems Solved This invention was used to solve several problems on the Lisa ADF where it was necessary to sense the location of the paper in multiple locations.

- 1) Space - we did not have more room in the ADF to place another optical sensor
- 2) ASIC IO lines - the ASIC in the product could not accept discrete input from any more sensors, all of the ports were utilized
- 3) Cost - it was not desirable to add any more cost to the product

Prior Solutions All of the prior solutions use multiple sensors or multi channel sensors. This has cost implications for the actual sensor, the extra GPIO lines on the ASIC, and the product size and complexity.

Description Though there are several embodiments of the design which were built and tested, the final design is as follows. There is a normal single channel optical switch which operates using a small beam of infrared light. That beam can be blocked or unblocked by something (in this case we'll call it a flag) and it gives a high or low signal to the processor depending on its state.

The flag in this case rotates through the beam. Instead of having just one 'blade' of plastic like normal, this flag has the blade with a small window cut in it. Initially the blade blocks the beam, but as the flag is rotated (by the paper), the window is exposed and the beam is then un blocked. Rotating the flag further moves the window away from the beam and again it is blocked. Finally, rotating the beam further still moves the blade completely out of the beam and the sensor is unblocked for the second time.

The signal to the processor looks like this: 1-0-1-0. The first 1 signals that no paper is present and the flag is fully down. The last 0 signals that there is paper present under the flag because the flag is fully rotated up. The middle two states (the first 0 and the second 1) are the critical ones because they denote

exactly where the leading or trailing edge of paper are.

Whereas a normal single channel optical switch and flag can only indicate the first and last states. The 'windowed' flag design can indicate 4 states, the middle two being very precise and critical to the function of the machine.

Advantages The advantage of the design is mostly of the cost and complexity side. The same solution could have been achieved by adding more sensors, but as product cost and size decrease, this becomes not an option. This design incorporates the same number of parts as the traditional design, but adds significant functionality.

Size is also a concern. This particular product did not have the room to place an additional sensor and flag.

Invention History

Published No

Announced [REDACTED]

Disclosed No

Next Three Months No

Described [REDACTED]
[REDACTED]

Government Contract No

Related Disclosure No

Innovation Workshop No

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Witnesses

Witnesses

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Classification

Recommended Classification IPG: Hardware: Mechanical - Media Handling

Legal Techword media movement - supply, picking, registration, feed rollers, shafts, vacuum belt feeders, drive system, encoders, pan-to-paper spacing, cockle control, ejection mechanisms, drying, wings, output, duplexing, post-print operations, and accessories

Keywords corner flags; edge detect flag, paper detect algorithm and optical switch

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Administrative Record

Date/Time Submitted [REDACTED]

PD Number 200312941

Date PD Number Assigned [REDACTED]

The Evolution of the Lisa Edge Detect Flag

Kevin Bokelman [REDACTED]

Purpose of the Edge Detect Flag

The primary purpose of an edge detect flag is to sense the leading edge of an original to be scanned in an ADF. By detecting the physical leading edge of the original, the system can then advance the original a predetermined amount (the physical offset of the flag from the scan line + ADF scan offset to ensure we don't scan off the page) before beginning to scan. This allows the ADF to start scanning the original at a very consistent position.

The secondary purpose of the edge flag is to determine where the trailing edge of the original to calculate an offset and stop scanning at the correct time.

The tertiary purpose of the edge flag is to indicate to the system that an original is jammed in the system. This may not be an actual jam, but it will alert the system anytime paper is present. If paper is present when it should not be, it is reported to the user as an original jam.

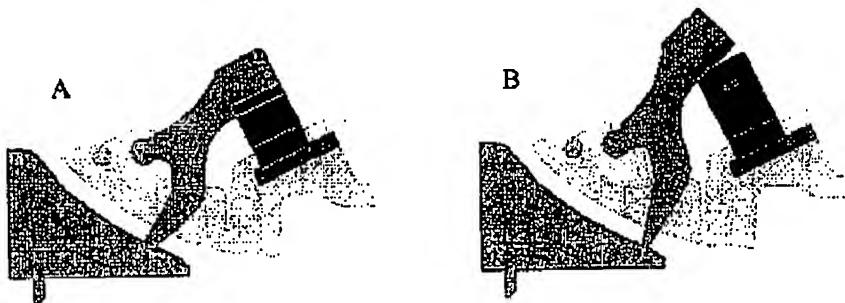
How it works

Most of our paper-feed systems use a very simple and inexpensive method of detecting paper. There is a flag and an optical interrupter. The flag is simply any obstruction in the paper path that is physically moved out of the way when paper moves through. The optical interrupter is a device that contains an infrared LED and a phototransistor. The flag is designed such that it will be blocking or unblocking the IR beam depending on the presence of paper. (Contrary to common sense, when the beam is blocked, the opto sensor puts out a high signal (+3.3V in the case of Lisa) and when it is unblocked, it produces a low signal (close to 0V).

The optimal place for this flag is between the Pre-Scan Roller and the scan line. This ensures that the Pre-Scan Roller, which is the precision drive roller of the system, has control of the original.

Initial (LP-1) Design of the Edge Detect Flag

The first design to be seen in production was a very simple flag that blocked the opto sensor when there was no paper present and unblocked it when there was paper present. Here are its blocked and unblocked states:



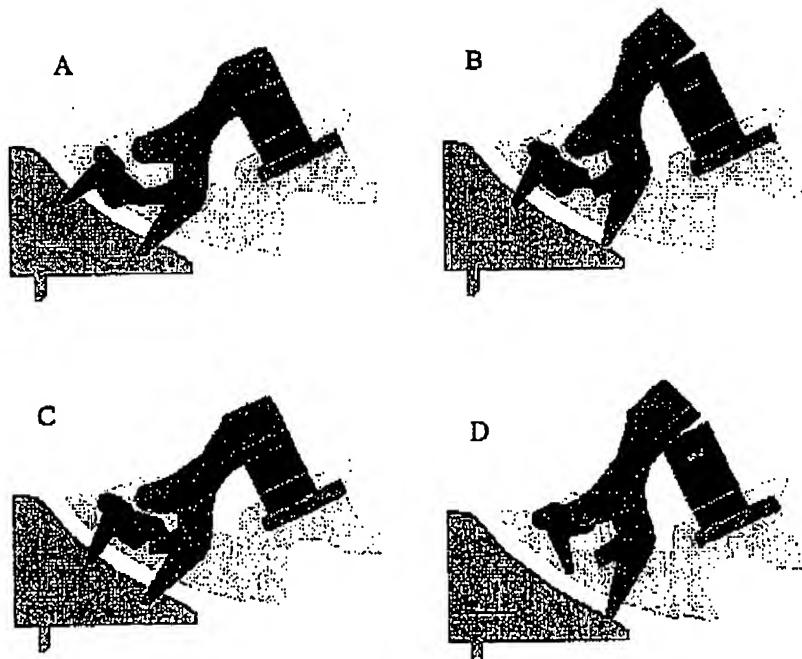
The paper passes through the gap between the Lower Chassis (light blue) and the ADF Bezel (purple). The IR beam is indicated in red. Picture A shows the flag blocking the sensor beam when there is no paper present. Picture B shows the flag being lifted up by paper in the paper path thus unblocking the IR beam. Note that the paper usually conforms to the outside of the paper path in a bend so it will be pressed up against the ADF Bezel (this is even more true with stiffer media or at colder or drier conditions).

But there were problems with this design:

- 1) Right before LP-1 several of the Lisa test beds started showing problems where the ADF scan would stop mid page and attempt to eject. What was happening was the obstructing end of the flag was not penetrating far enough into the paper path so that media could not fully raise the flag. In the middle of the page, the flag could drop just enough to block the sensor and would indicate an end of page. The solution for LP-1 was to lengthen this portion of the flag by 0.65mm. The lesson from this is that even though the CAD looks very good in terms of having enough clearance to unblock the sensor, all of the play in the system add up to erode much of that margin.
- 2) The top of form measurements from CIMation were horrible. The LP-1 units measured a variation of about 6mm in top of form (the spec is $\pm 1.5\text{mm}$). This is inherent to the architecture of the ADF. The Lisa ADF (APU) needs to switch modes between picking paper and scanning paper. It utilizes a drag-clutch swingarm design to allow the motor to switch directions while continuing to drive the rollers in the same direction. The swingarm has quite a bit of variation and uncertainty in when it engages and disengages from the gears. Since we switched modes after the leading edge was sensed, all of this swingarm engagement variation (4mm) was added to the leading edge sensing variation (2mm).
- 3) The obstruction portion of the flag had only a tiny amount of clearance in the Y direction from a rib on the ADF Bezel. It had the potential to get hung up on the rib and not fully reset in the down position.

Dual (Trigger) Flag Design

To solve the problem #2 of the LP-1 design required a rethinking of the flag concept. We needed a flag that could sense the leading edge of an original in the Pick mode and then sense it again after the ADF had switched to drive mode. We did not have the option of putting in another opto sensor because there were no more GPIO pins available on the ASIC. Here is the first concept:



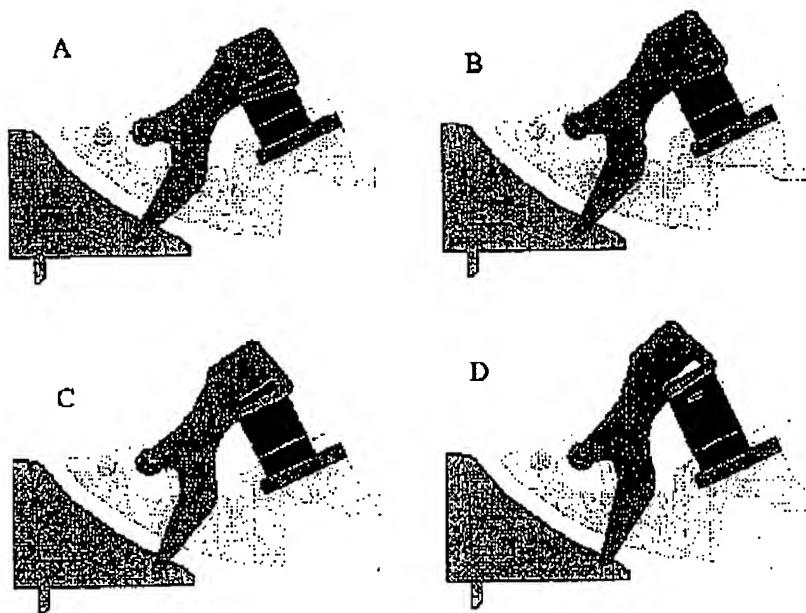
Sequence of operation:

- No paper is present. The trigger flag (dark blue) is down as well as the edge flag (light blue). The opto sensor is blocked.
- Paper pushes the trigger flag during the pick mode. The trigger flag pushes the edge flag and the sensor is unblocked.
- The trigger flag continues to rotate up but allows the edge flag to fall back down, blocking the sensor again. Now the system switches modes from pick to scan.
- The leading edge of the original (now being driven in scan mode) lifts the edge flag and unblocks the sensor for the second time. Now an accurate distance can be driven to the scan line.

Aside from needing an addition flag, this design had another flaw. It was possible for the system to start off in position C (due to a paper jam, vibration, etc.) because the trigger flag cannot reset itself, it needs the edge flag to be lifted in order to reset. If an original was fed through in this setting, the firmware would have to compensate (once it realized that the flag did not drop again) and calculate the offset to the scan line. In this case, we would expect to see a 6mm variation in top of form like LP-1.

Short Window Flag (Q3434-40083)

It was desirable to come up with a design that could give this two-stage feedback without an additional part that had to be reset. The design seen below is based on using the opto sensor like an encoder.

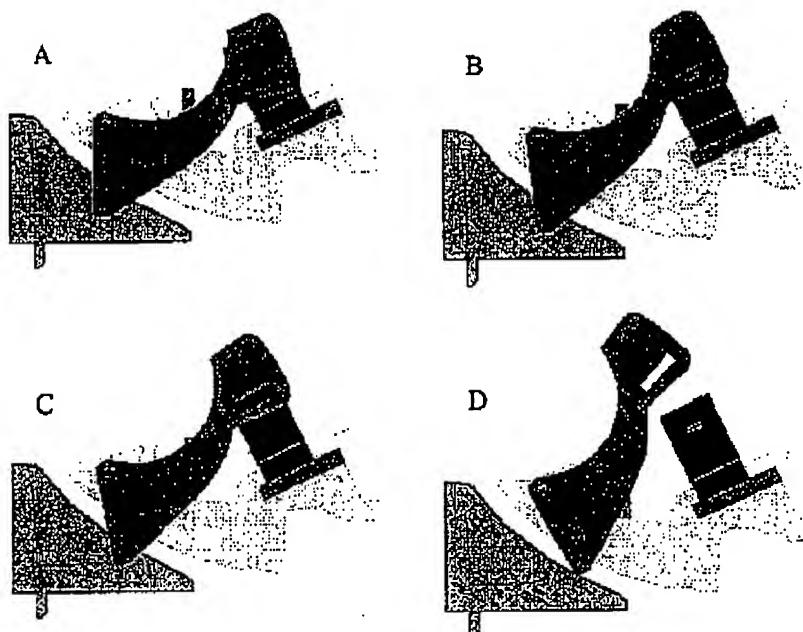
**Sequence of operation:**

- A) No paper is present. The opto sensor is blocked.
- B) Paper pushes the flag during the pick mode. The small window in the flag allows the sensor to become unblocked. Now the system switches modes from pick to scan.
- C) The leading edge of the original (now being driven in scan mode) lifts the edge flag even further and blocks the sensor for the second time with the spoke of material.
- D) The leading edge of the original lifts the edge flag further still and unblocks the sensor for the second time. Now an accurate distance can be driven to the scan line.

This design too faces a problem. Compared with the LP-1 design, the flag has to rotate further in order to completely unblock the sensor. More material was added to the paper path obstruction, but, since LP-1 was marginal with respect to not rotating far enough, this design will be as well.

Long Window Flag (Q3434-40084)

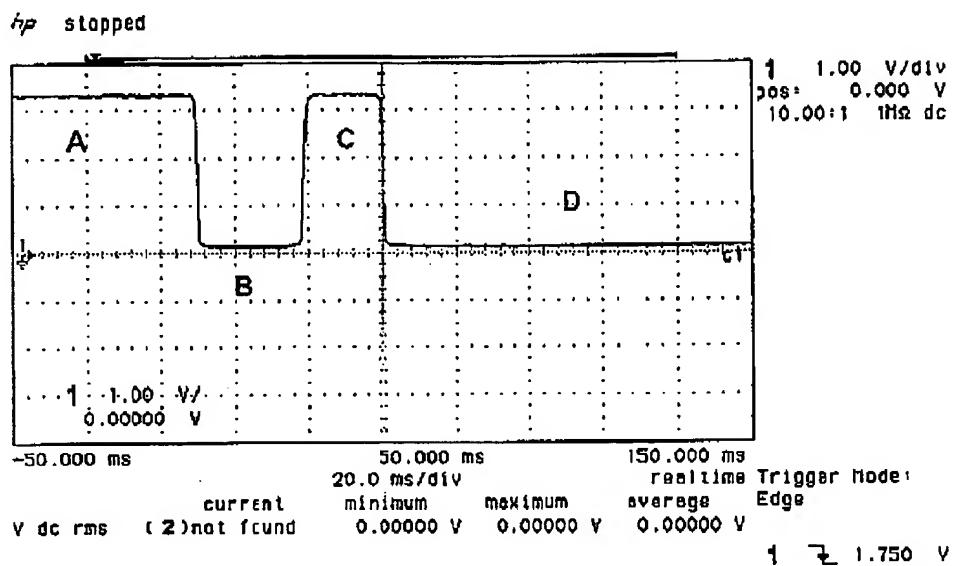
The secondary pivot point that was added to the Lower Chassis to enable the trigger flag can be used as the pivot point for a longer, higher gain flag.



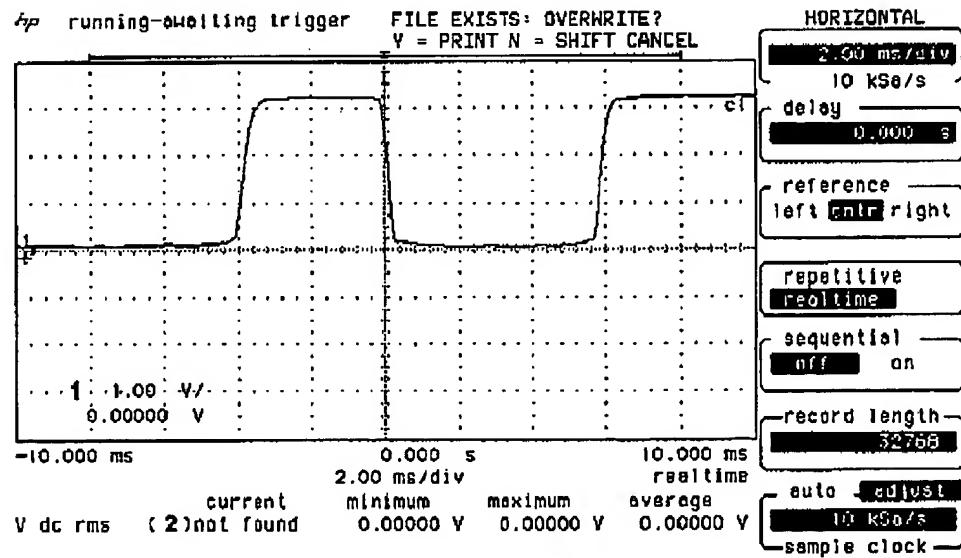
Sequence of operation (same as the Short Window Flag):

- A) No paper is present. The opto sensor is blocked.
- B) Paper pushes the flag during the pick mode. The small window in the flag allows the sensor to become unblocked. Now the system switches modes from pick to scan.
- C) The leading edge of the original (now being driven in scan mode) lifts the edge flag even further and blocks the sensor for the second time with the spoke of material.
- D) The leading edge of the original lifts the edge flag further still and unblocks the sensor for the second time. Now an accurate distance can be driven to the scan line.

The following is output of the edge sensor when the paper is driven through at 1 inch per second:



This is the leading edge of the paper triggering the window flag.



This is the trailing edge of paper going off of the flag. Note the scale on this plot is 10X that of the plot above, so this is actually a very quick event.